THE ONTOGENY OF THE VOCAL SAC OF THE AUSTRALIAN LEPTODACTYLID FROG, *LIMNODYNASTES TASMANIENSIS*

by M. J. TYLER*

Summary

TYLER, M. J., (1975).—The ontogeny of the vocal sac of the Australian leptodactylid frog *Limnodynastes tasmaniensis*. *Trans. R. Soc. S. Aust.* **99**(2), 85-87, 31 May, 1975.

The ontogeny of the vocal sac of *Limnodynastes tasmaniensis* proceeds from initial bilateral evaginations of the mouth floor, through median fusion to a unilobular, submandibular structure. The acquisition of pigmentation by the submandibular skin is a concomitant process. It is suggested that the vocal sac evolved by a path now reflected by ontogeny, and involving progressive bilateral herniation.

Introduction

Vocal sacs occur only in male anurans and, in most species, comprise inflatable, epithelium-lined chambers located between the hyoid plate and the superficial mandibular musculature. Data on the ontogeny of vocal sacs are limited to studies on only a few, mostly African, species (Inger 1956; Inger & Greenberg 1956). The available information is so inadequate that the possible contribution of ontogeny to an understanding of the evolution of vocal sacs has not been assessed. At present there is no published information on the ontogeny of the vocal sacs of any of the 300 (approx.) species of frogs found in Australia and New Guinea.

The Australian leptodactylid species *Limnodynastes tasmaniensis* represents an ideal initial subject for studies of vocal sac ontogeny. This is because the superficial mandibular musculature of adults has already been described in detail, and there are published observations on variation in the position occupied by the vocal sac when it is inflated (Tyler 1971).

Material and Methods

Of 646 specimens of *Limnodynastes tasmaniensis* in the South Australian Museum, one series was found to exhibit ontogenetic variation in the extent to which the vocal sac intrudes above the superficial mandibular musculature. This series comprises 18 male specimens from a group of 68 males collected at West Beach near Adelaide on 1 September 1963 (SAM, R5290). The snout to vent length of the 18 males ranges from 30 to 34 mm.

Dissections were performed with the aid of a low-power binocular microscope, and measurements made with a pair of dial callipers. The muscles were stained with the reversible iodine/potassium iodide stain described by Bock & Shear (1972), in order to differentiate the vocal sac from the surrounding striated muscles. Muscle and vocal sac terminology follow that of Tyler (1971).

Observations

Secondary Sexual Characteristics

The secondary sexual characteristics of *Limnodynastes tasmaniensis* are as follows: males possess a unilobular, submandibular vocal sac, yellow pigmentation of the submandibular skin and glandular nuptial pads on the first and second fingers. Females bear broad lateral fringes to the first and second fingers, and sometimes to the third.

Vocal Sac Ontogeny

The earliest step in the progress towards the development of vocal sacs involves the formation of a shallow and elongate involution of the floor of the mouth on one side of the tongue. There is a slight elliptical, ventral depression with a mediad inclination (Fig. 1A), and the lateral margin of the depression is level with the lateral border of the anterior cornu of the hyoid.

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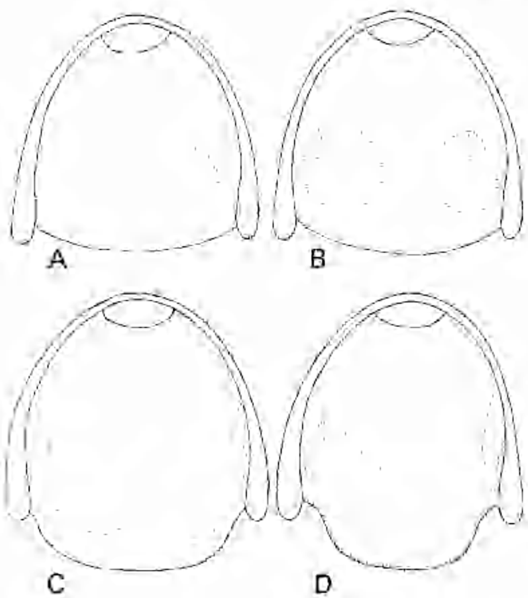

Fig. 1. Selected progressive stages in ontogeny of vocal sac. *A*. Single, elliptic ventral depression. *B*. Bilateral expansion mediad. *C*. Further mediad and initial caudad development. *D*. Medial unity of separate sacs.

In four specimens, development was confined to such an evagination on the left side; in a fifth there were bilateral evaginations. From these slight folds the vocal sac develops bilaterally, and as far as could be determined quite concomitantly, into roughly circular bags intruding between the superficial, ventral, mandibular musculature and the deep intermandibular muscles situated above them (Fig. 1B). At this stage of progress mediad development is more pronounced than anterior or posterior development. Simultaneously, that area of the mouth floor between the anterior cornu and the mandible becomes depressed, rendering the aperture to each portion of the sac more conspicuous.

As the two halves of the vocal sac approach one another, their posterior margins extend further caudad (Fig. 1C). This posterior enlargement is accompanied by comparable enlargement of the interhyoideus muscle into a slight lobe, extending beyond the post-articular extremities of the mandibles. Ultimately the vocal sac occupies the entire muscular lobe, becoming united medially by loss of the common medial wall (Fig. 1D).

The presence and extent of submandibular dermal pigmentation was found to provide an accurate external index of the presence, and stage of development, of the vocal sac structure. In specimens lacking the initial evaginations in the mouth floor, the submandibular skin was either entirely unpigmented or else bore a few scattered chromatophores at the periphery of the mandibles. Development of the evaginations was accompanied by an increase in the density of pigmentation and of its medial limit. The pigmentation, and the appearance of the bright yellowish background color of the submandibular skin, progressed in an identical sequence until, at completion of vocal sac development, the skin was entirely yellow.

Discussion

Beyond the sphere of its intrinsic interest, ontogeny can contribute to an understanding of the evolution of structure. In the present situation the progression of the vocal sac from paired, lateral evaginations to a single, large sac could readily be regarded as a recapitulation of evolutionary history. However, the nature of the progression also indicates why the anuran vocal sac originates in the way that it does.

The floor of the mouth is supported by the hyoid plate and its processes, and by muscles communicating between the hyoid and the mandibles. These supporting structures provide what can be visualised as a broad and complex sling in which the only gaps are a narrow lateral zone on each side of the tongue, so situated between the anterior cornua and the mandibles. In all anurans possessing vocal sacs, apertures originate within these 'unsupported' zones.

The probable steps that lead to the evolution of vocal sacs in this species, or its ancestral stock, can be reconstructed quite readily. Assuming an increase in the pressure of the buccal cavity during vocal activity, the existing sites of the vocal sac apertures are probably the areas of least resistance: in these regions the superficial tissue is of a rather elastic nature, and presumably subject to the greatest distension. It follows that the first stage in the ontogeny of the vocal sac of *Limnodynastes tasmaniensis* is precisely that initial event. Subsequent stages could well have arisen from little more than progressive bilateral herniation.

References

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THE PRE-SETTLEMENT VEGETATION OF THE MT GAMBIER AREA, SOUTH AUSTRALIA

*BY R. J. DODSON**

Summary

DODSON, J. R. (1975).-The Pre-Settlement Vegetation of the Mt Gambier area, South Australia. *Trans.* R. *Soc.* S. *Aust.* **99**(2), 89-92, 31 May, 1975.
There are some conflicts as to the nature of the pre-settlement vegetation formations around Mt Gambier and Glencoe. European settlers long ago cleared the areas of their vegetation cover.
Pollen analysis of Brownes Lake sediment reveals that the most likely formation around Mt Gambier consisted of open grassland with perhaps a sparse cover of woody taxa.